EXETER PUBLIC WORKS DEPARTMENT

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January 15, 2015

United States Environmental Protection Agency
Region I – New England
5 Post Office Square – Suite 100
Boston, MA 02109-3912
Attn: Joy Hilton, Water Technical Unit (Mail Code: OES04-3)

Re: **NPDES Permit No. NH0100871**
Administrative Order on Consent Docket No. 13-010
Quarterly Progress Report, 4th Quarter, 2014, Sixth Report

Dear Ms. Joy Hilton:

This report is being made in accordance with the Administrative Order on Consent, Section IV.C., for the fourth quarter period of October 1, 2014 to December 31, 2014.

Per Section IV.C.1.a., activities undertaken during this reporting period directed with achieving compliance with this Order include:

- The Town continues to participate in WISE (Water Integration Squamscott (River) Exeter), principal members are Rob Roseen and Renee Bourdeau, both of Geosyntec.
- The Town continues to take a full suite of influent characterization sampling from weekly 24 hour composite sampling for new WWTP Facilities Design purposes with one round of sample splitting with a second certified lab. The two sets of lab results were very close. Prior to this sampling the Isco sampler suction lines were replaced and moved to the center of the grit building outlet pipe to improve sampling conditions.
- On October 8th there was a meeting to discuss converting two of the Town's lagoons to constructed wetlands. NHDES (Tracy Wood, Lori Sommer, Frank Richardson), USEPA(Ed Reiner), UNH, W-P Engineering and others (by phone conference) attended.
-
- Facilities Design Work Shop #6, was held with the Town's consultant, Wright-Pierce Engineering, on October 3rd

- On December 3rd a public presentation was made to the Board of Selectmen by Wright-Pierce Engineering of the "Wastewater Facilities Plan". A copy of that power point presentation is included with this report.
- Underwood Engineering was separately contracted to explore a regional approach to NPDES permit compliance. Their draft report "Regional Waste Water Disposal Options" is included with this report.
- A detailed sludge depth profile of all three lagoons was done. This included composite sampling for TCLP and metals analysis.

- <u>Wright-Pierce Engineering activities completed for the Town's Wastewater Facilities Plan in the past quarter:</u>
- All dates are 2014, unless otherwise noted.
- Developed upgrade alternatives for building systems.
- Addressed Working Group comments on the preliminary draft of the existing conditions and alternatives analyses.
- Completed Working Group preliminary draft of the Recommended Plan documents, including cost estimates for the project components and preliminary phasing plan.
- Initiated work on financial affordability analysis.
- Coordinated with the Town regarding the regional analysis of connection to Portsmouth Pease WWTF.
- Coordinated with WISE team on cost estimates for the WWTF upgrades.
- Coordinated with NHDES on lagoon decommissioning.
- Developed approach and safety plan to assess lagoon sludge quantity and quality.
- Prepared for Workshop No. 6 with DPW staff.
- Continued coordination with CAPE team to get data from their project.
- On-going coordination with WWTF influent sampling program.
  Coordinated with Town staff
- Reviewed Portsmouth City Council meeting footage to understand the City's intended approach to evaluate expanding the Pease WWTF to include flows from Peirce Island WWTF (Sept 29).
- Prepared for and attended Workshop No. 6 with DPW staff and Water & Sewer Advisory Committee appointee (October 3).
- Prepared for and attended a site meeting and conference call with DES, UNH, EPA, NH Fish & Game and the Nature Conservancy (October 8).
- Coordinated with WISE team on cost estimates for the WWTF upgrades (October 10).
- Addressed Working Group comments on the supplemental material, including the Recommended Plan and Funding/Financing sections. Submitted an updated October preliminary draft report (October 22).
- Completed field testing of sludge quantity in the three lagoons with input and oversight from NHDES (October 20, 27 and 29). Sent representative samples to a contract laboratory for analysis regarding sludge quality.
- Prepared for and attended Workshop No. 7 with DPW staff (October 31).
- Coordinated with Underwood Engineers on cost estimates for the Pease Regional alternative.
- On-going coordination with WWTF influent sampling program.

- Attend WISE meeting (November 6).
- Prepared for and attended Workshop No. 8 with DPW staff (November 25).
- Prepared draft presentation material for a joint Water & Sewer Advisory Committee and Board of Selectmen meeting to present the preliminary draft report, including materials on costs and effectiveness of non-point source nitrogen control measures.
- Addressed Working Group comments on the supplemental material, including the Recommended Plan and Funding/Financing sections. Submitted an updated October preliminary draft report (October 22).
- Coordinated with Underwood Engineers on cost estimates for the Pease Regional alternative.
- On-going coordination with WWTF influent sampling program.
- Updated presentation materials for a joint Water & Sewer Advisory Committee and Board of Selectmen meeting to present the preliminary draft report, including materials on costs and effectiveness of non-point source nitrogen control measures. Presentation completed on December 3.
- Prepared memorandum to address WSAC comment regarding phasing costs (December 10).
- Continued preparation of memorandum regarding findings of sludge quantity and quality evaluation.
- Began to compile data for the Annual TN Report due in January 2015.
- On-going coordination with WWTF influent sampling program.
- Updated presentation materials for a joint Water & Sewer Advisory Committee and Board of Selectmen meeting to present the preliminary draft report, including materials on costs and effectiveness of non-point source nitrogen control measures. Presentation completed on December 3.
- Prepared memorandum to address WSAC comment regarding phasing costs (December 10).
- Continued preparation of memorandum regarding findings of sludge quantity and quality evaluation.
- Began to compile data for the Annual TN Report due in January 2015.
- On-going coordination with WWTF influent sampling program.

Per Section IV.C.1.b., no plans, reports or other deliverables required by this order were completed or are submitted during this reporting period, with the exception of DMRs.

Per Section IV.C.1.c., expected activities to be taken during the next quarter to achieve compliance with the Order include:

- During the first quarter of 2015 Underwood Engineers will do a power point presentation of their "Regional Waste Water Disposal Options" to the Town Board of Selectmen and the Town's Water and Sewer Advisory Committee.
- Weekly 24-hour composite total nitrogen final effluent sampling will continue. The Town continues to report (on the DMR), monthly average, daily max loadings and daily max concentrations for total nitrogen. The Department continues to collect weekly 24-hour composite final effluent samples for total nitrogen. This

commenced with the July 2013 Discharge Monitoring Report (DMR); monthly average, daily max loadings and daily max concentrations for total nitrogen have been reported.

Please call if you have any questions or need any additional information.

Sincerely,

Town of Exeter, New Hampshire

Michael Jeffers

Michael Jeffers
Water & Sewer Managing Engineer

cc. Tracy Wood, P.E., NHDES Wastewater Engineering Bureau
Russell Dean, Town Manager
Jennifer Perry, DPW Director
Paul Vlasich, P.E., Town Engineer
Michael Jeffers, Water & Sewer Managing Engineer
Scott Butler, Senior Operator

Town of Exeter
Wastewater Facilities Plan

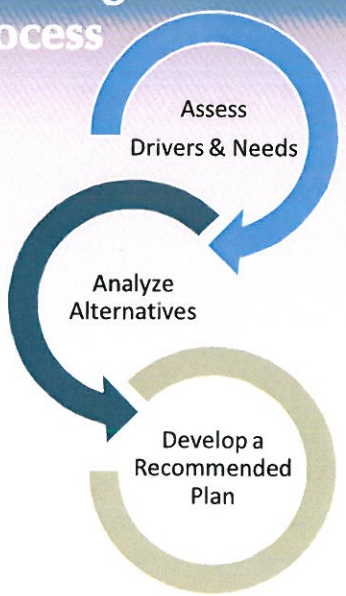
Presented By:
Ed Leonard, PE

Date:
December 3, 2014

WRIGHT-PIERCE
Engineering a Better Environment

TOWN OF EXETER · FOUNDED 1638 · NEW HAMPSHIRE

Planning Process



- Identify infrastructure needs
- Identify upgrade options
- Identify optimal PS/NPS nitrogen strategy
- Recommend capital improvements
- Identify funding mechanisms and schedule

2

Why is this Plan Needed?

- Declining water quality in the Squamscott River and in Great Bay

Photo: National Estuarine Research Reserve System website

3

Why is this Plan Needed?

- NPDES Permit
  - Issued in 2012 by EPA
  - Achieve <3 mg/l TN
- AOC (Administrative Order on Consent)
  - Legal agreement with the EPA in 2013
  - Achieve 'interim limit' of <8mg/l TN

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Additional AOC Requirements

- Begin "Tracking & Accounting" for TN
- Implement baseline river monitoring
- Coordinate with NHDES & municipalities
- Develop a Nitrogen Control Plan (2018)
- Implement the Nitrogen Control Plan
- Evaluate effectiveness of NCP (2023)

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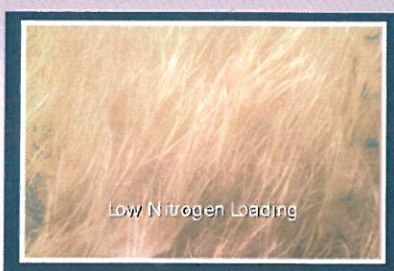
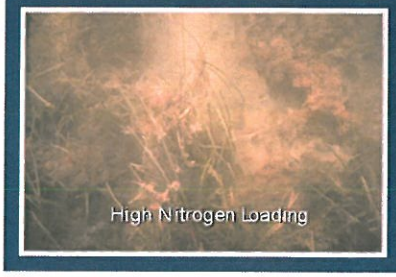
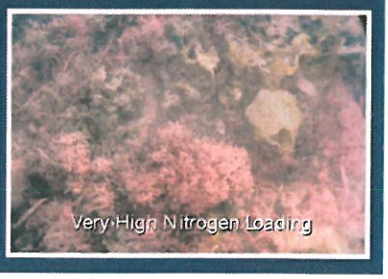
Why is the AOC Focused on Nitrogen



As nitrogen loading increases, healthy eelgrass and diverse animal communities decline as algae replace eelgrass and smother animal communities; eelgrass disappears and fisheries decline.





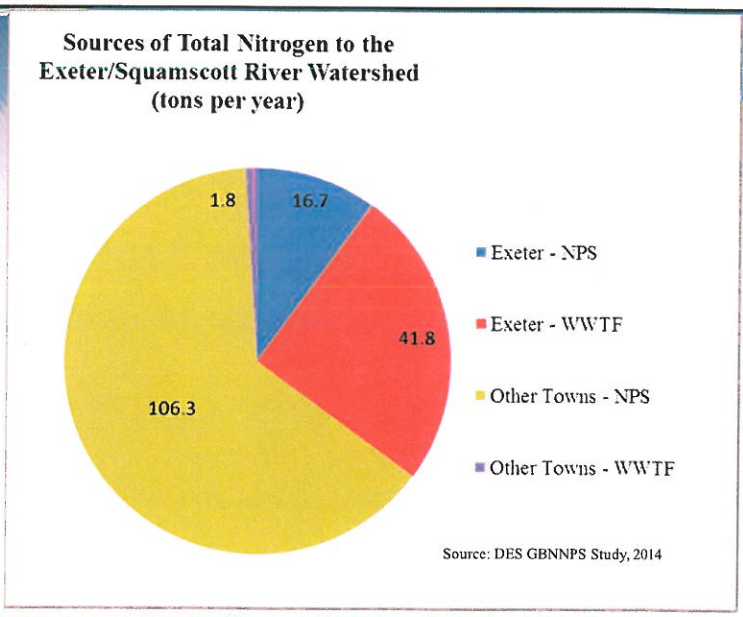
6

What are the Nitrogen Sources and Delivery Mechanisms?

Inputs	Delivery Method	Attenuation Mechanism*
• Food (i.e., wastewater) • Fertilizers • Atmospheric N • N-fixing crops	• WWTFs • Groundwater • Precipitation • Stormwater	• Storage in soil & plants • Removal in crops & woods • Microbial action • Aeration in surface water

* Natural attenuation results in 74% nitrogen removal

7



Nitrogen control will require cooperation from other towns

8

How Much N Reduction Required?

- There is debate on this
- NHDES:
  - Put Great Bay and Squamscott River on the 303(d) list
  - Established Numeric Nutrient Criteria based on "weight of evidence" approach in June 2009.
  - Issued Great Bay Nitrogen Loading Analysis in December 2010 with "threshold" values

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How Much N Reduction Required?

- Great Bay Municipal Coalition sued NHDES
  - GBMC & NHDES agreed to a Peer Review
  - Joint Report of Peer Review Panel - Feb 2014
  - Settlement Agreement - Apr 2014
- Currently there are no "firm" criteria
  - WQ driver is still present
  - Validates the adaptive approach in the AOC
  - Emphasizes need for water quality monitoring
  - Coalition communities are upgrading WWTFs

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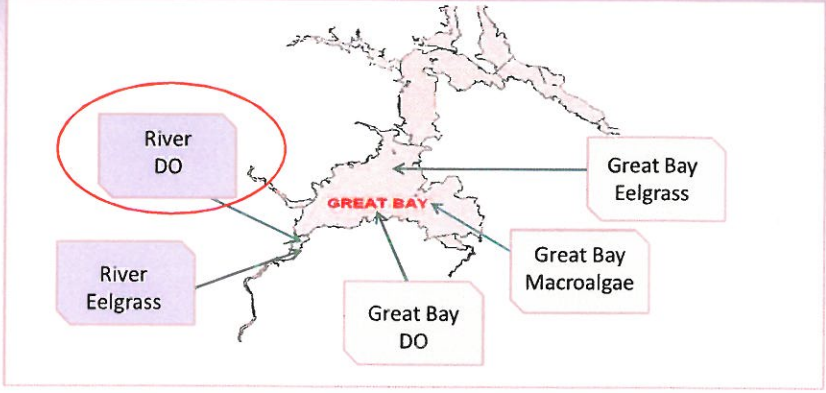
How Much N Reduction Required?



For Planning, we are using 140 tons/yr as the "Estimated Threshold"

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Wastewater Infrastructure

- Collection System
  - 51.8 miles of sewers
  - 2 combined sewer overflow (CSO) locations
  - Main Pump Station
- WWTF
  - Originally constructed in 1964 (lagoons)
  - Upgraded in 1988 (lagoons) and 2002 (outfall)
  - Effluent to Squamscott River

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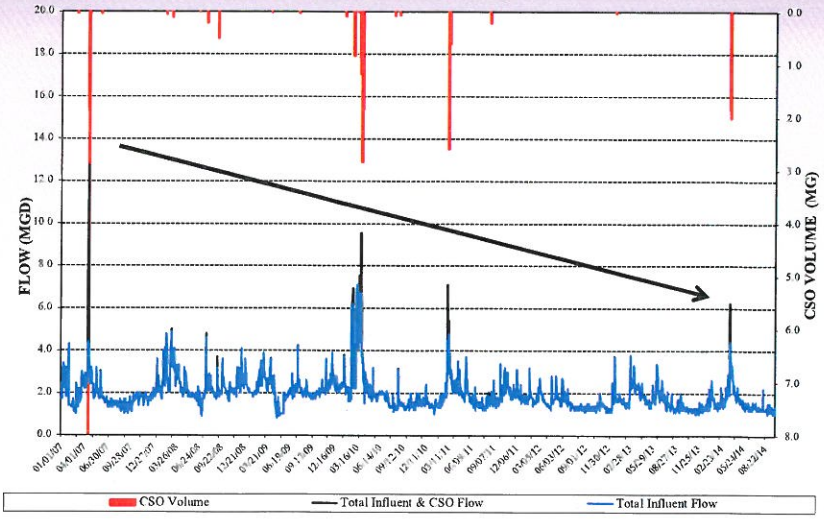
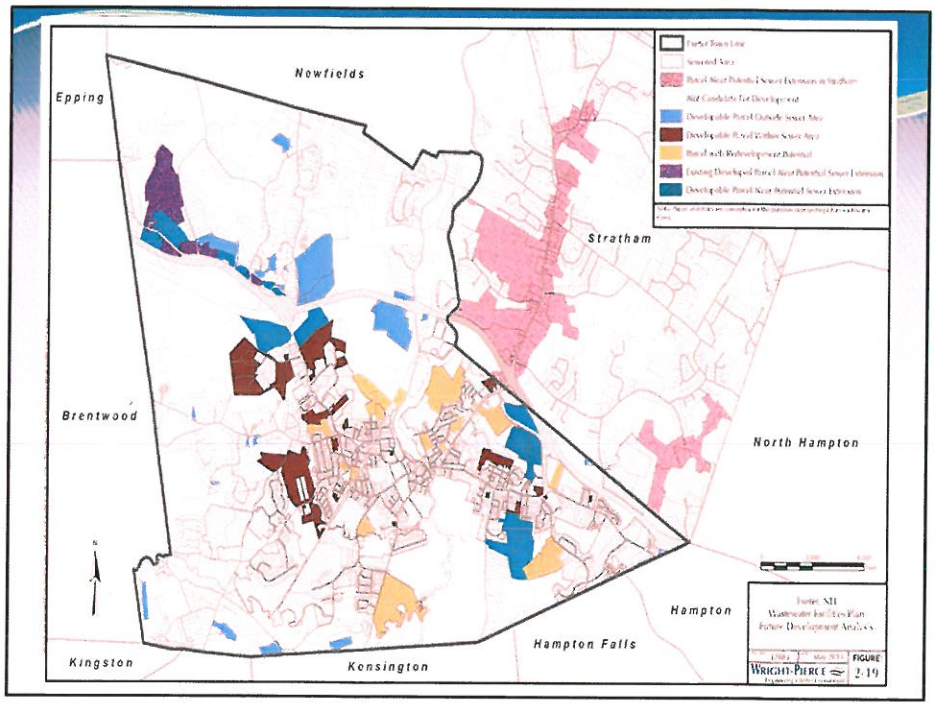
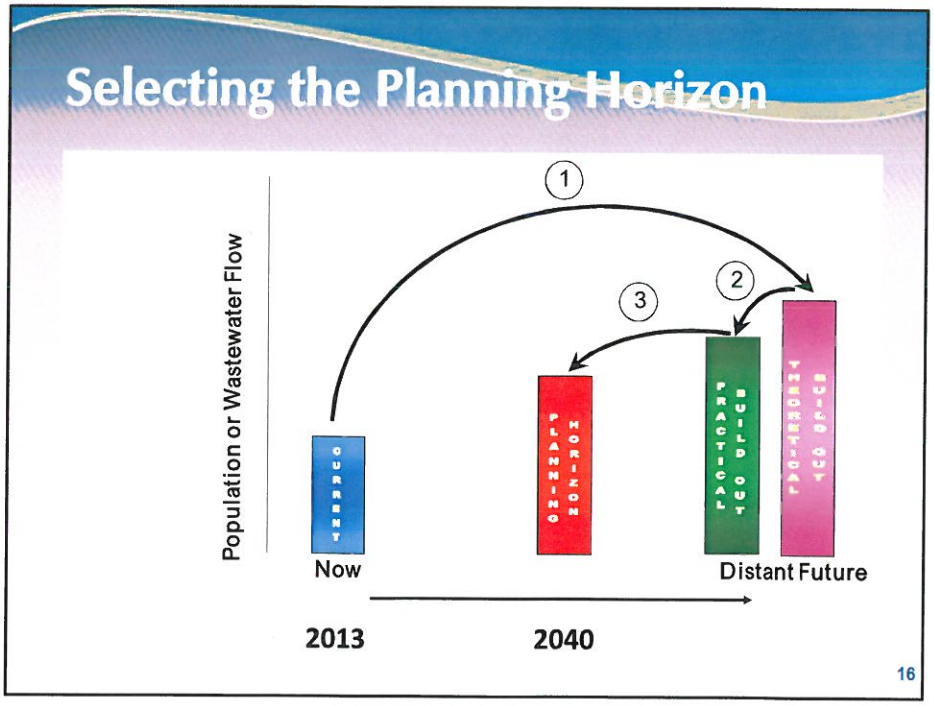
WWTF and CSO Flows

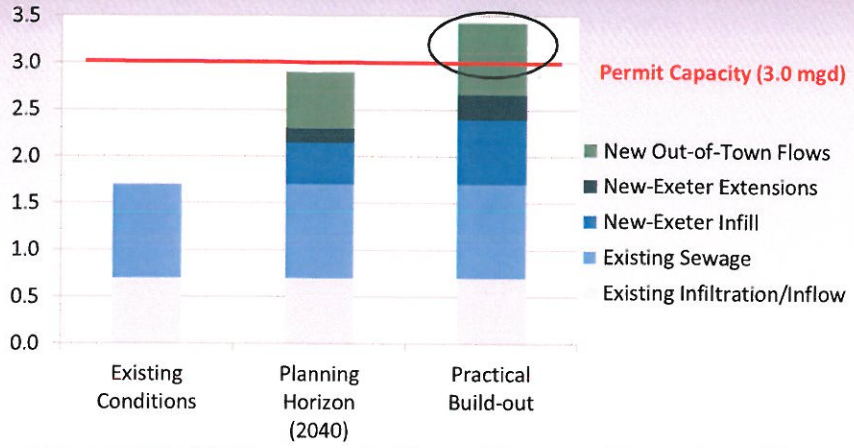


14


Epping
Newfields
Stratham
Brentwood
North Hampton
Hampton
Hampton Falls
Kingston
Kensington
FIGURE
2-19


Selecting the Planning Horizon
Population or Wastewater Flow
1
2
3
CURRENT
PLANNING HORIZON
PRACTICAL BUILD OUT
THEORETICAL BUILD OUT
Now
Distant Future
2013
2040
16

WWTF – Flow Capacity



May need to limit new out-of-town flows, and/or reduce I/I flows, and/or negotiate a higher permit limit

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WWTF – Process

Conventional WWTF

Exeter WWTF

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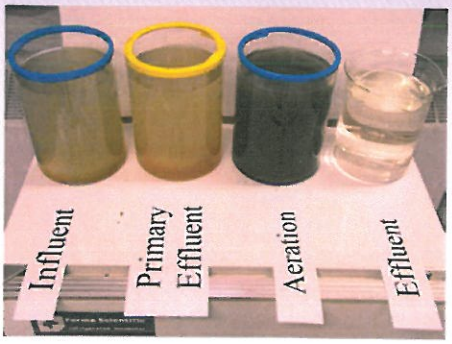
WWTF – Effluent Quality

Exeter WWTF



Conventional WWTF

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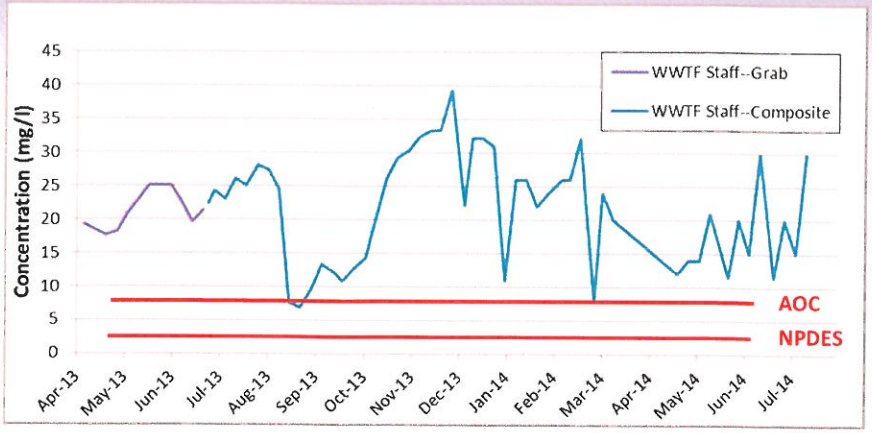
WWTF – Effluent Nitrogen



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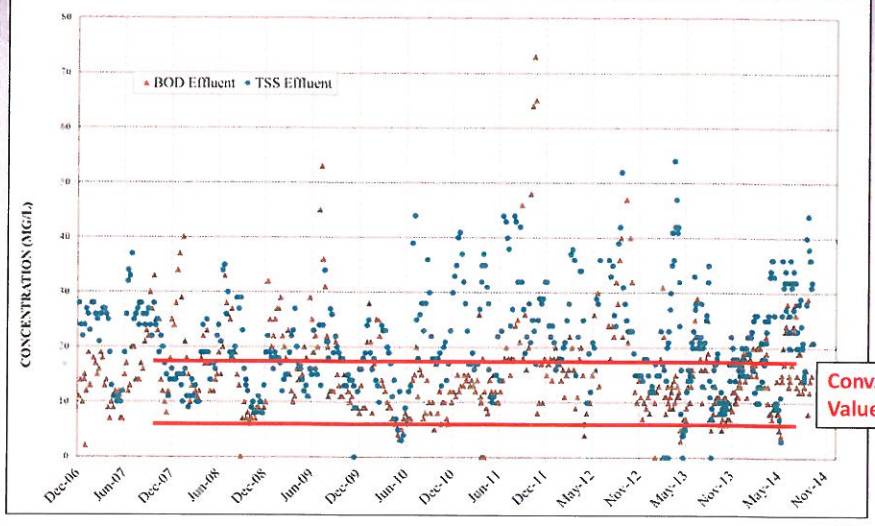
WWTF – Effluent BOD and TSS



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WWTF & MPS - Conclusions

- Main Pump Station needs upgrades to reduce CSOs
- Outdated WWTF can't meet NPDES
- Most of the treatment equipment has exceeded useful life
- Comprehensive upgrade required to a conventional plant

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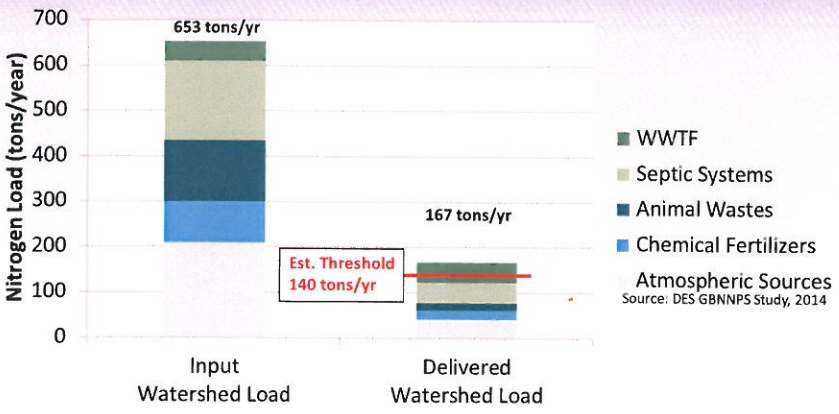
Current* NPS Nitrogen Loads to Exeter/Squamscott Watershed



* Excludes future TN loads due to growth in the watershed.

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Exeter River Watershed
NPS Nitrogen Reductions Required

WWTF Effluent TN	Current Conditions [1,2]	Planning Horizon [1,3,4]
8-mg/l	3%	16%
5-mg/l	-3%	5%
3-mg/l	-8%	-3%
"0-mg/l" (Pease WWTF)	-12%	-10%

1. Based on estimate of threshold load for River DO criteria of 140 tons/year
2. Based on WWTF flow of 1.7 mgd
3. Based on WWTF flow of 3.0 mgd
4. Assumes future growth is near 'nitrogen neutral'
5. Pease Option assumes 8mg/l effluent with 10% of load flowing to Great Bay
6. Negative values indicate amount below the estimated threshold

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Exeter River Watershed
NPS Nitrogen Reductions Possible

	Fraction of NPS Load	Estimated Reduction	Net Reduction
Septic	24%	0% [1]	0%
Animal/Agricultural	17%	10% [2]	1.7%
Chemical Fertilizer	24%	20% [2]	4.8%
Atmospheric Deposition	35%	30% [3]	10.5%
Total Net Reduction			17.0%

1. Set a near nitrogen-neutral policy for new growth
2. Best management practices
3. Clean Air Act mandates result in long-term atmospheric reductions at no cost

Up to 17% NPS load reduction at low cost
Up to 10% NPS load reduction at 'no cost'

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Important to Focus NPS Efforts on Most Effective TN Removal Methods

Management Approach	Assumed Input Load	Resultant Delivered Load	Effective Removal
Secondary WWTF	1	0.67	33%
Standard Septic System, <200m	1	0.60	40%
Denitrifying Septic System, <200m	1	0.30	70%
WWTF with TN Removal to 8 mg/l	1	0.27	73% ★
Standard Septic System, >200m	1	0.26	74% ★
WWTF with TN Removal to 5 mg/l	1	0.17	83%
Denitrifying Septic System, >200m	1	0.13	87%
WWTF with TN Removal to 3 mg/l	1	0.10	90%

1) Effective removals based on methodology used in DES GBNNPS, 2014

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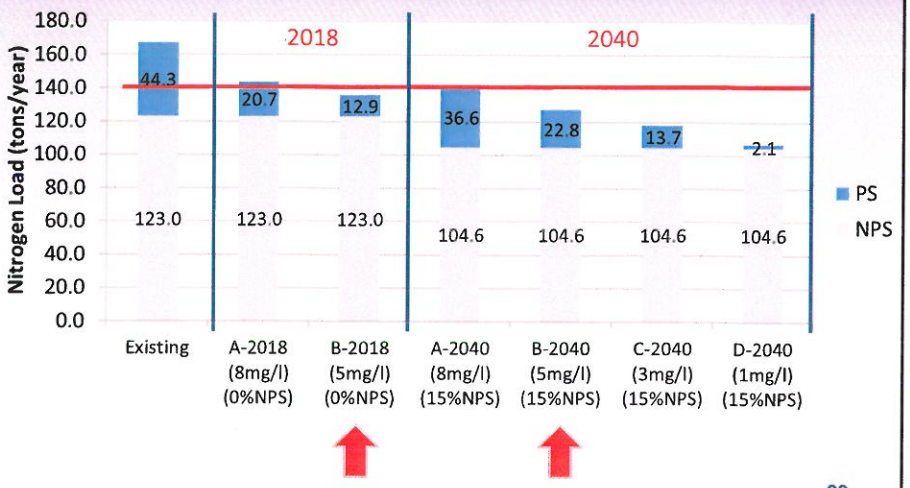
Important to Focus Efforts on Most Economical TN Removal Methods

Annualized Cost per Pound of Nitrogen Removed	Rank	PW $$ per lbTN removed
Atmospheric Deposition Reductions	1	$0
Chemical Fertilizer Reduction Program	2	$30
Agricultural BMPs	3	$50
WWTF Upgrade to 5-mg/l (1)	4	$290
WWTF Upgrade 3-mg/l (1)	5	$300
WWTF Upgrade to 8-mg/l (1)	6	$330
Sewer Extension, <200m to Shore (2,3)	7	$3,000
On-Site Denit. Septic Systems, <200m to Shore (3)	8	$5,000
Rain Gardens, Street Sweeping, Bioretention, Pervious Pavement	9	$500 - $8,000
Sewer Extension, >200m to Shore (2,3)	10	$9,000
On-Site Denit. Septic Systems, >200m to Shore (2,3)	11	$17,000

(1) WWTF at 3.0 mgd; (2) Conveyed to WWTF at 5-mg/l; (3) Includes impacts of natural attenuation

Nitrogen Management Strategies



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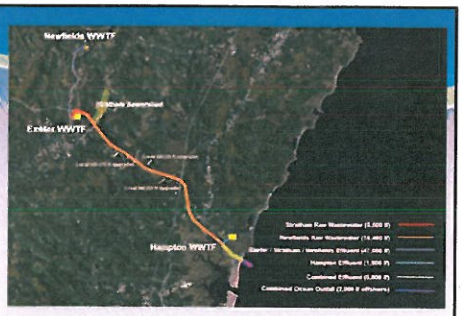
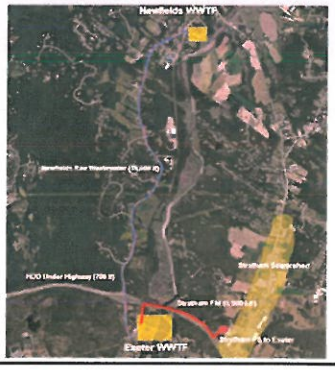
WWTF Alternatives

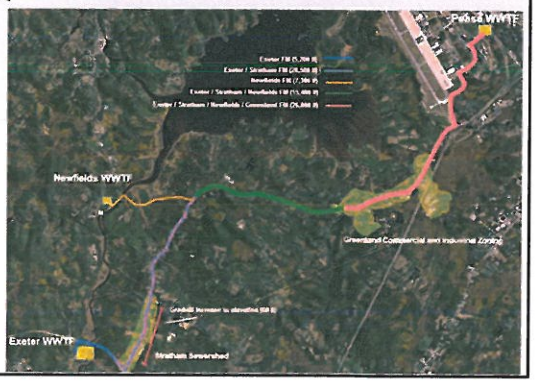
Alternative 1 (On-Site)

Alternative 2 (Hampton)

Alternative 3 (Pease)







WWTF Alternatives Analysis (April 2014)

	Alternative 1 On-Site	Alternative 2 Hampton	Alternative 3 Pease
Total Capital	Low	Mid	High
Total Annual O&M	Low	Mid	High
50-Yr Present Worth	Low	Mid	High
Exeter Share of 50-Yr PW *	**Low**	**High**	**Mid**
Effluent TN Concentration	3-mg/l	8-mg/l	8-mg/l
Effluent TN Conc. to Great Bay	**3-mg/l**	**0-mg/l**	**<1-mg/l**
Permitting	Certain	Uncertain	Uncertain
AOC Timeframe	Certain	Uncertain	Uncertain
Recommendation	**Pursue**	**Drop**	**Pursue**

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On-Site WWTF
Nitrogen Removal Alternatives

Identified:

More Common	Less Common
Modified Ludzack-Ettinger (MLE)	Moving Bed Bioreactor (MBBR)
Four-Stage Bardenpho	Biolac
Sequencing Batch Reactor (SBR)	BioMag
Oxidation Ditch	Rotating Biological Contactors (Aerobic/Anoxic)
Schreiber Cyclic Aeration	De-ammonification
Integrated Fixed Film Activated Sludge (IFAS)	Trickling Filters
Membrane Bioreactors (MBR)	Breakpoint Chlorination
Denitrification Filters	Air Stripping

Short-Listed:

- MLE plus Denitrification Filter
- Bardenpho plus Traditional Filter
- SBR plus Denitrification Filter
- Biolac plus Denitrification Filter

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On-Site WWTF
Nitrogen Removal Alternatives

- Process configuration for 8/5/3-mg/l
- Modeling and tank sizing
- Phasing considerations
- Planning-level site layouts
- Planning-level cost estimates
- Evaluative criteria

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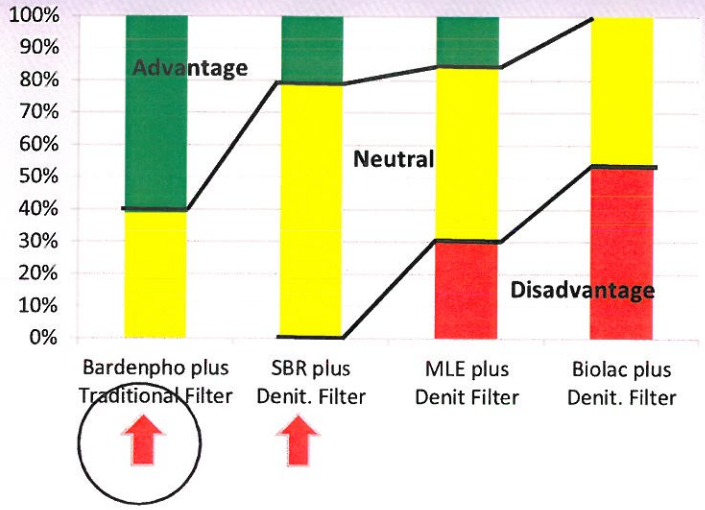
Selected Nitrogen Removal Alternative



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Lagoon Decommissioning

	Reclaim Land	Restore Wetlands	Fill with Water
Cost for Decommissioning	$5M	$5M	$5M
Cost for Finishing the Site	$10M	$1M	$0M
Grants Available?		✓	
Increase Flood Storage in River?		✓	
Potential Recreational Uses:			
Athletic Fields	✓		
Birding/Walking Trails		✓	✓
Boat Launch	✓	✓	✓

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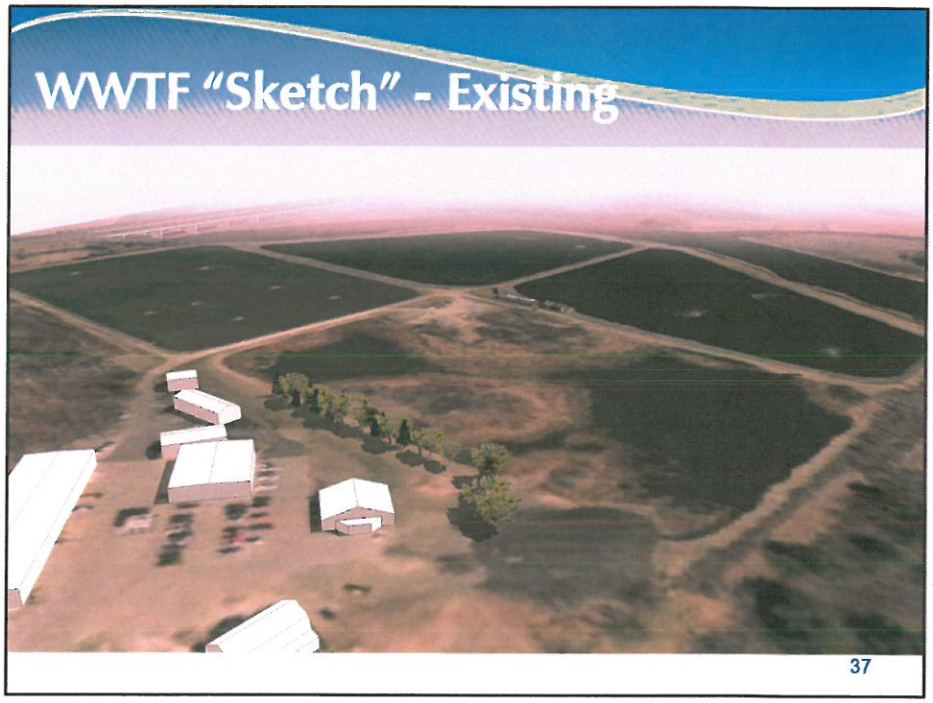
WWTF "Sketch" - Existing
37


WWTF "Sketch" – Restore Wetlands
38

Recommended Plan for On-Site WWTF

- Point Sources of Nitrogen
  - Upgrade WWTF to TN 5-mg/l $40M
  - Upgrade Main Pump Station (CSO) $ 5M
  - Decommission Lagoons $ 6M
- Non-Point Sources of Nitrogen $tbd
  - Meet AOC requirements (T/A, NCP, AMP)
  - Fund river monitoring program
  - Update ordinances to address "future" TN
  - Encourage State to foster watershed cooperation

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WWTF Alternatives Analysis (Updated November 2014)

	Alternative 1 On-Site	Alternative 3 Pease
Total Capital	$45.9M	$67 to $76M
Total Annual O&M for Treatment & Disposal	$1.85M	$3.7 to $4.7M
50-Yr Present Worth	$104M	$183 to $223M
Exeter Share of 50-Yr Present Worth	**$104M**	**$119 to $155M**
Effluent TN Concentration	3-mg/l	8-mg/l
Effluent TN Concentration to Great Bay	3-mg/l	<1-mg/l
Permitting & AOC Timeframe	Certain	Uncertain
50-Yr PW of Exeter Cost for 15% NPS Reduction	**$3 to $6M**	**$0M**
Total 50-Yr PW of Exeter PS/NPS Costs	**$107 to $110M**	**$119 to $155M**

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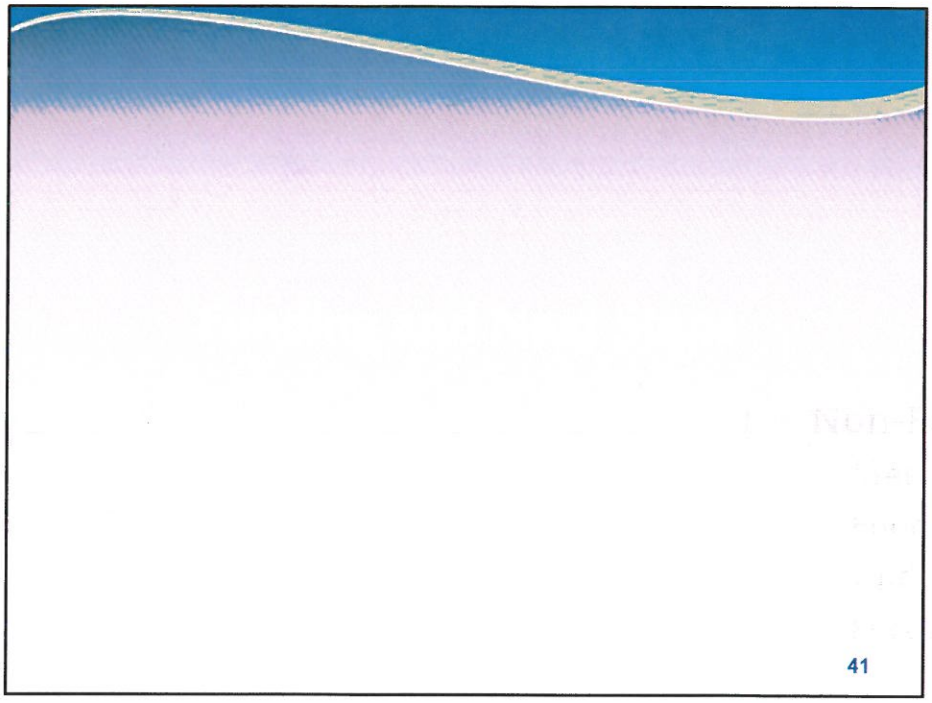

Program Funding

- Loans
  - DES CWSRF, 20-year loan at 3.4%; or
  - NH Municipal Bond Bank, 20-years at 4.5%
- Grants
  - None secured at this time
  - Targeting US Economic Development Admin
  - Targeting DES State Aid Grant (30% grant)
    - Need vocal town support to the NH Legislature

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Costs for Typical Residential User

- Existing Sewer Fund plus costs resulting from the Recommended Plan
- Sewer User Rates for Single Family Household
  - Current rate for 90ccf per yr - $410/yr
  - Increase rate to $890/yr with SAG (1.3% MHI)
  - Increase rate to $1,090/yr without SAG (1.6% MHI)
- Taxation
  - Assumes no contribution from taxation

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Affordability Strategies

- Update user charge system and connection fees
- Consider regional host fees
- Optimize other expenditures
- Consider phasing project implementation
- Evaluate watershed fees

	LbTN/capita/yr	$$/capita/yr
Exeter - Status Quo	8.4	$0
Rest of Watershed – Status Quo	7.4	$0
Exeter – 2018 (NPDES/AOC)	4.4	$450

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Near-Term Schedule

- WWTF and Facilities Planning
  - Decisions – Winter 2015
  - Start Design – Winter 2015
  - Bidding – April to May 2016
  - Initiate Construction – June 2016 (AOC)
  - Complete Construction – June 2018 (AOC)

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Closing Comments

1. TN management will require effort for next 10+yrs.
2. Watershed-wide NPS TN management is warranted. An estimated 17% reduction in NPS TN is feasible at relatively low cost.
3. A WWTF upgrade is needed. AOC requires TN 8-mg/l, however TN 5-mg/l is more cost effective.
4. Best available information suggests that Town may be able to avoid WWTF TN 3-mg/l and that on-site WWTF will be most cost effective.

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Closing Comments

5. Capital costs can be reduced through phasing.
6. User rates can be reduced through partnering with Stratham and/or Newfields. Capacity is available through the Planning Horizon.
7. State leadership is needed for inter-municipal collaboration and affordability.

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Next Steps

- Address comments from Exeter
- Conclude 'on-site' or 'off-site' approach
- Decide on Stratham/Newfields connections
- Update Facility Plan
- Submit plan to EPA and DES
- Initiate Design activities and WQ monitoring
- Continue with AOC tasks and I/I efforts

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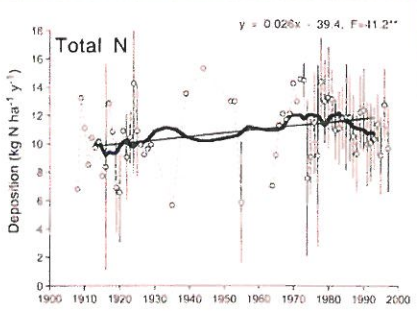
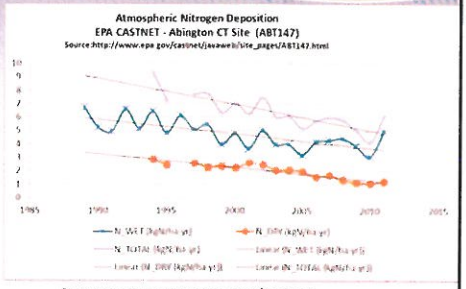
Questions & Discussion

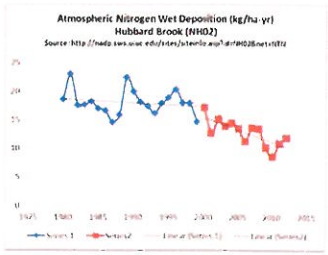
Atmospheric Deposition



Source: "Historical Changes in Atmospheric Deposition to Cape Cod", Bowen, Valiela, 2001, Fig. 5



Data Source: www.epa.gov/castnet



Data Source: http://nadp.sws.uiuc.edu

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WWTF Alternatives Analysis (April 2014)

	Alternative 1 On-Site	Alternative 2 Hampton	Alternative 3 Pease
Capital *	$48.4M	$51.8M	$81.6M
Annual O&M for Total Sewer Budget	$3.4M	$3.8M	$5.8M
50-Yr Present Worth *	$121.9M	$132.6M	$206.8M
Exeter Share of 50-Yr Present Worth *	$121.9M	$119.3M	$144.6M
Effluent TN Concentration	3-mg/l	20-mg/l	8-mg/l
Exeter Share of 50-Yr Present Worth * for Effluent TN at 8-mg/l	n/a	$150M	n/a
Effluent TN Concentration to Great Bay	3-mg/l	0-mg/l	<1-mg/l
Permitting	Certain	Uncertain	Uncertain
AOC Timeframe	Certain	Uncertain	Uncertain

* Includes treatment and disposal costs for Stratham and Newfields; Includes collection system costs.

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TOWNS OF EXETER AND STRATHAM, NH

Regional Wastewater Disposal Options

DRAFT

November 21, 2014

UNDERWOOD engineers

Portsmouth, New Hampshire

File NO. 1834

Table of Contents

Executive Summary

Background

The wastewater treatment facility (WWTF) in Exeter, NH is currently under an EPA Administrative Order on Consent (AOC) to meet new NPDES permit limits for total nitrogen. In 2013, the WWTF was issued a permit to discharge treated effluent into the Squamscott River with total nitrogen levels not to exceed 3.0 mg/l. Since the WWTF does not currently meet those standards, the AOC requires that the Town begin construction of a new WWTF or develop other means to meet the permit requirements.

The Town of Stratham, NH is interested in providing wastewater collection and treatment service to its Business District and other commercially zoned areas along Route 108 and Route 33. Stratham is currently without its own WWTF and has explored constructing a new WWTF as well as options to convey its wastewater to the Exeter WWTF. Due to the high costs of developing a new WWTF, the Towns of Stratham and Exeter have decided to cooperatively evaluate a regional wastewater treatment strategy. This study summarizes the evaluation.

Significant Findings

The City of Portsmouth currently has two WWTFs, Pease WWTF and Peirce Island WWTF. The City has indicated a willingness to consider accepting flows from Exeter and Stratham at the Pease facility. This study evaluates the scope and costs necessary for the conveyance wastewater to Pease and associated treatment improvements. A summary of the needed improvements includes the following:

- Exeter WWTF Modifications
    - Construct a new pumping station with design point of 2,600 gpm (3.7 MGD) at 190 feet of TDH (equalized) located at the Exeter WWTF site to convey effluent to Pease.
    - Construct a wet well that includes combined equalized flows from Exeter and Stratham.
    - Decommission lagoons (with 1 modified for stormwater equalization)
- Construct an interceptor for conveyance of equalized wastewater from Exeter to the Pease WWTF. The preferred route is:
    - 12.7 miles in length
    - Located primarily within the NHDOT ROW along Routes 101, 108 and 33.
    - Note, for the purposes of this study, it is assumed that Stratham will construct a pumping and conveyance system to the Exeter WWTF at their cost (not included in this evaluation).
- Pease WWTF Modifications
    - Construct a new headworks to accommodate additional regional flow.

- Construct additional Sequence Batch Reactors.
- Construct additional primary clarifiers.
- Construct sludge storage tank
- Improve conveyance system from the Pease WWTF to the outfall (50%).
- Expand/improve Pease outfall in the Piscataqua River.

Planning Costs

The following table provides a summary of the capital costs for the identified modifications and conveyance system as well as O&M costs. These preliminary costs are for planning purposes only, based on assumptions in this report. A further breakdown of the WWTF, conveyance and O&M costs can be found in Appendix E.

Opinion of Costs Based on Alternative 1(20 Year Flows)

	Summary of Low Range Opinion of Costs	Summary of High Range Opinion of Costs
Total Capital Costs	**$66.3M**	**$76.3M**
Total O&M	**$3.6M**	**$4.6M**
Present Worth (20 Years)	**$132.8M**	**$156.3M**

Recommendations

Based on this evaluation, the following is recommended:

- Compare regional costs from this study to those costs presented in the pending Exeter Facility Plan.
- Continue to discuss opportunity with Portsmouth.
- Monitor Portsmouth's discussion on conveying Peirce Island's sanitary waste to Pease. This may provide additional cost incentives to a regional Pease option. Note: the City of Portsmouth is currently evaluating the regional option as well.

1.0 Background

The Exeter Wastewater Treatment Facility (WWTF) is a secondary treatment facility located in Rockingham County, NH that is designed to handle an average daily flow of 3.0 MGD. The WWTF discharges its treated effluent to the Squamscott River, which feeds into the Great Bay before exiting to the Atlantic Ocean by way of the Piscataqua River. Currently the Town of Exeter is under an EPA Administrative Order on Consent (AOC) to meet new NPDES permit limits, primarily for Nitrogen removal.

The Town was issued a NPDES Permit in 2013 requiring an effluent limit of 3.0 mg/l of Total Nitrogen at the WWTF outfall in the Squamscott River. The Town's WWTF does not meet the limitations set by the NPDES Permit. The AOC was issued requiring the limits to be met by June 2018. Due to the high construction and operating costs of a new WWTF and possible other benefits, the Town of Exeter has partnered with the Town of Stratham to explore the feasibility of connecting to a regional WWTF at the City of Portsmouth Pease WWTF.

2.0 Goals and Objectives

The following are the main goals of this study:

- Identify the technical feasibility of a joint wastewater collection system to convey wastewater from Exeter and Stratham to the City of Portsmouth Pease WWTF.
- Develop costs for a regional option that can be compared to published costs for previously (or pending) identified solutions for Exeter, Stratham, and Pease.
- Identify challenges and opportunities of this option as compared to individual municipality options currently being considered.

3.0 Basis of Design

The following information was used to evaluate feasibility and costs of this project:

1. Pease Wastewater Treatment Facility Evaluation (UE, October 2013)
2. Wastewater Management Concept Plan (WP, March 2011)
3. Exeter-Stratham Intermunicipal Water and Wastewater System Evaluation Study (Kleinfelder, December 2012)
4. Sewer Extension Study Town of Greenland (Tighe and Bond, July 2012)
5. Information from the pending 201 Facility Plan Update Exeter (Wright Pierce, ongoing)
6. 201 Facilities Plan Update Portsmouth (Underwood Engineers, June 30, 1999)
7. NPDES Permit Modification – Outfall Improvements Pease (Underwood Engineers, May 1997)
8. Wastewater Master Plan and LTCP Update Portsmouth (Brown and Caldwell with Weston and Sampson, November 2010)

3.1 Design Flows

The design flows of the regional interceptor were based on the following information:

Table 1 : Summary of Flows[1]

Town	Buildout Flow (MGD) from Reports	20 year Flows (MGD)	Current Flows (MGD)
Exeter (Equalized)	3.0	2.6	~1.6
Stratham (Equalized)[2]	0.675	0.4	0[2]
Pease[3]	1.35	1.35	~0.6
Total	**5.025**	**4.35**	**~1.8**

1. **Although not in the table, it should be noted that Newington discharges 0.4 MGD into the Pease WWTF outfall prior to discharge into the Piscataqua River.** Greenland has prepared a sewer build-out study and identified potential sewer flows of 0.174 to -.34MGD
2. Stratham is currently served by on-site individual private septic systems.
3. The Pease WWTF is currently designed for 1.2 MGD capacity.

The evaluation of the conveyance system from Exeter to Pease was based a 20-year flow of 3 MGD from Exeter and Stratham (equalized). The Pease WWTF evaluation was based on a 20-year design flow of 4.35 MGD.

Currently the Town of Stratham does not have a collection system or a wastewater treatment facility. This report assumes that Stratham will construct their own collection system and convey the wastewater to the Exeter WWTF headworks. Alternatively, a pump system could be designed to discharge to the interceptor force main, which may require modifications to the interceptor design.

3.2 Interceptor Routing

The interceptor connecting the Exeter WWTF to the Pease WWTF was evaluated with the following assumptions:

- One pumping station located at the Exeter WWTF site
- One force main from Exeter to Pease without intermediate pumping (i.e. no gravity sections)
- Stratham would connect to Exeter's headworks in Exeter.
- Interceptor construction includes:
    - HDPE SDR 9 butt fused pipe
    - Open cut 5-6 feet deep trench
    - Directional Drilling at significant crossings
    - Air relief structures at high points
    - Cleanout/blow-off structures at every mile (+/-)

The Node Map found in Appendix A (Figure 1) depicts the general interceptor configuration.

4.0 Engineering Evaluation

4.1 Exeter WWTF Headworks and New Pumping Station

The following modifications will be made to the Exeter WWTF in order to meet the design requirements of this project:

- Existing headworks to remain
- New pump station located at the Exeter WWTF with a design point of 2,600 gpm (3.7 MGD) at 190 feet of TDH (equalized).
- Installation of a wet well with an equalization tank sized for diurnal flows (~740,000 gpd).
- Decommission lagoons (1 lagoon to remain for stormwater flow equalization).
- Maintain outfall for possible future use as stormwater discharge.

4.2 Conveyance Piping Hydraulics

Based on the 20 year flows from Exeter and Stratham and Conveyance Alternative 1 below, the regional interceptor was evaluated as follows:

- 3 HDPE Pipe sizes were evaluated: 18", 20", and 24"
  - 18" would require higher O&M costs due to higher head and may not meet future flow requirements.
  - 24" required the lowest O&M costs due to lower head, but may be too large for current flows.
  - 20' SDR9 HDPE pipe met present and future design requirements and was a cost effective solution for wastewater conveyance.

A flows velocity range for design was based on 2 to 4 feet per second. A 20" interceptor force main provides a practical flow range of 1,332 gpm to 2,570 gpm (1.9 MGD to 3.7 MGD). See pump and conveyance calculations in Appendix F.

4.3 Conveyance Route

Based on discussions with the Towns of Exeter and Stratham as well as the New Hampshire Department of Transportation and local utility companies (Unitil, Spectra Energy and PSNH), the following routing alternatives for the interceptor were selected for further evaluation (see attached meeting minutes, Appendix B):

- Alternative 1 – Highway Route (NHDOT)

- Alternative 2 – Utility ROW Route 1 (NHDOT, PSNH, and Unitil corridor)
- Alternative 3 – Utility ROW Route 2 (Spectra Energy, PSNH, and Unitil corridor)

Each alternative is shown in Appendix A, Figures 2-5.

4.3.1 Conveyance - Alternative 1 (Recommended)

Alternative 1 (Appendix A, Figure 3) connects the Exeter WWTF to the Pease WWTF by installing the interceptor within the NHDOT ROW along highways 101, 108, and 33 from the WWTF. The 12.7 mile interceptor will be located in a gas utility right of way and follow Route 101 to the Route 108 intersection. It follows Route 108 North through the Stratham Business District and continues on Route 33 through the Town of Greenland for approximately 7.3 miles. From the NHDOT ROW it will be located in Grafton Road and connect to the Pease WWTF on Corporate Drive.

In order to limit the amount of repaving required for this alternative, the interceptor will be installed along the unpaved shoulder of the road. Primary pavement repairs will be limited to the driveway and roadway crossings.

Advantages:

- Better access during construction and maintenance
- Fewer private ROW issues (will work primarily within NHDOT ROW)
- Will require less Directional Drilling

Disadvantages:

- Longest route
- Construction will be in public areas (traffic issues will increase during construction)
- Will require more road repair and traffic maintenance during construction (Stratham Business District, and roadway/driveway crossings)

4.3.2 Conveyance - Alternative 2

Alternative 2 (Appendix A, Figure 4) includes installing the interceptor along routes 101, 108, 33 and a Utility Corridor for gas and electricity. The 12.3 mile interceptor initially follows the same route as Alternative 1. From the Exeter WWTF it follows Route 101 and then north on Route 108 for approximately 1.5 miles. Before it reaches the Route 108/33 intersection, it will connect to the Power and Gas line corridor near Butterfield Lane. The interceptor will travel approximately 6 miles within this corridor, until it reaches Route 33 in Greenland near the Travels Center of America complex. Once on Route 33, the interceptor follows the same path as Alternative 1 to the Pease WWTF on Corporate Drive.

Advantages

- Shorter distance than Alternative 1
- More of the construction will be outside of public areas.
    - Less traffic interruptions
    - Less road repair (minor road/driveway crossings within Utility ROW)
    - Possibly faster construction

Disadvantages

- Most of the project would be within private ROWs.
    - Additional costs and time to gain permission for ROW access may be needed.
- Limited space is available inside of the Utilities ROW.
- Most of the construction and maintenance would be remote and not as easily accessible.
- Will require more directional drilling than Alternative 1.

4.3.3 Conveyance - Alternative 3

Alternative 3 (Appendix A, Figure 5) is the shortest alternative at 11.3 miles. This alternative initially avoids public highways and roads by using a gas utility corridor near the Exeter WWTF. After using this corridor for approximately 3.2 miles, the interceptor merges onto the same utility corridor as Alternative 2. From there the interceptor uses the same route as Alternative 2 to connect to the Pease WWTF.

Advantages

- Shortest Distance of all the Alternatives
- Most of construction will be outside of public areas.
    - Less traffic interruptions
    - Less road repair
    - Possibly faster construction

Disadvantages

- Most of the project would be within private ROWs.
    - Additional costs and time to gain permission for ROW access may be needed.
- Limited space is available inside of the Utilities ROW.
- Most of the construction and maintenance would be remote and not as easily accessible.
- Will require more directional drilling than Alternative 1.

Table 2 provides a summary of each of the Routes:

Table 2: Segment Length for Each Conveyance Alternative from the Exeter WWTF to the Pease WWTF

Corridor Segment	Alternative 1	Alternative 2	Alternative 3
Gas Line Corridor	3,800	3,800	16,900
Route 101	1,300	1,300	0
Private Drive	1,500	1,600	0
Route 108	9,800	7,700	0
PSNH/Gas	0	31,700	24,000
Route 33	38,500	6,800	6,800
Grafton Road	5,300	5,300	5,300
Corporate Drive	6,900	6,900	6,900
TOTAL	**67,100 ft. 12.7 Miles**	**65,100 ft. 12.3 miles**	**58,900 ft. 11.2 miles**
Opinion of Cost	**$32.8 M**	**$31.4 M**	**$29.6 M**

For the purposes of this evaluation, Alternative #1 is recommended because it is located within existing road right of ways (Town and NHDOT). Alternatives #2 and #3 required significant land acquisition efforts; which may impact the costs and schedules due to co-locating a force main within gas and power line corridors.

4.4 Pease WWTF Improvements

Based on meetings and discussions with NHDES and the City of Portsmouth, the Pease WWTF would need to be designed to meet an effluent limit of 8 mg/L Total Nitrogen. Previous work has been done to consider Pease as a regional WWTF (Brown and Caldwell with Weston and Sampson, 2010). The costs and improvements from the Brown and Caldwell report were the basis for identifying the needed improvements as part of this evaluation. Specifically, Cost Estimate Scenario 3B of the Wastewater Master Plan was the basis for the costs (Appendix E). In summary, the improvements needed to accommodate the 20-year design flows of 4.35 MGD, are as follows:

- Construction of a new headworks
- Construction of new sequencing batch reactors (SBR) based on equalized flow from Exeter.
- Construct additional primary clarification
- Other modifications including disinfection, biosolids processing, and storage

4.5 Pease Effluent Conveyance and Outfall

The Pease WWTF effluent is conveyed to the Piscataqua River through an approximately 1.5 mile long gravity sewer main. The outfall itself is constructed of 8 diffusers and was installed in

1999. An evaluation of the Pease Outfall was not completed. However, it was assumed that 50% of the conveyance system to the outfall would require improvements to accommodate the 20-year flows. In summary the following was included in this cost evaluation:

- Replace 50% (+/-) of gravity conveyance system to outfall
- Extend or modify outfall

Since the permitting requirements of increasing the discharge to the outfall at this location are unknown, it is possible that the effluent would have to be conveyed to the Peirce Island WWTF outfall. Previous studies (Brown and Caldwell and Weston and Sampson, 2010) have identified the cost of this option to be $14M. This would avoid the need to construct outfall improvements at Pease ($4M), so the net cost impact to the project would be $10M which is included in the high range of the costs below.

5.0 Opinion of Costs and Schedule

5.1 Opinion of Costs

Table 3 provides a summary of the capital and O&M costs. These preliminary costs are for planning purposes only, based on the assumptions in this report. A further break down of the WWTF, conveyance and O&M costs can be found in Appendix E. The costs are presented with a high and low range to establish a potential cost range due to the possibility of additional outfall improvements.

Table 3: Opinion of Costs Based on Routing Option #1 Buildout Flows (5.025 MGD)

	Summary of Low Range Opinion of Costs	Summary of High Range Opinion of Costs
Conveyance and Exeter PS	$33M	$33M
Pease WWTF and Outfall	$34M	$44M
Total Capital Costs	**$67M**	**$77M**
O&M (Exeter Pumping Station)	$0.7M	$0.7M
O&M Pease WWTF	$3.0M	$4.0M
Total O&M	$3.7M	$4.7M
Present Worth (50 Years)	$151M	$182M

Note: 1. Present worth is based on i= 4%

Table 4 provides a 20 year cost of this project adjusted for the 20-year flows of 4.35 MGD.

Table 4: Opinion of Costs Based on Routing Option #1 and 20-Year Flows (4.35 MGD)

	Summary of Low Range Opinion of Costs	Summary of High Range Opinion of Costs
Conveyance and Exeter PS	$33M	$33M
Pease WWTF and Outfall	$33M	$43M
Total Capital Costs	**$66M**	**$76M**
O&M (Exeter Pumping Station)	$0.7M	$0.7M
O&M Pease WWTF	$2.9M	$3.9M
Total O&M	$3.6M	$4.6M
Present worth (20 Years)	$133M	$156M

Note: 1. Present worth based on i= 4%

A summary of the costs is listed below:

- Installation of an interceptor from Exeter WWTF to Pease WWTF
- Construction of a new pumping station at Exeter WWTF
- Construction of a dry weather equalization tank at Exeter WWTF and lagoon decommissioning
- Construction of a new headworks and primary clarifiers at Pease WWTF
- Construction of new SBRs at Pease WWTF
- Modifications to Pease WWTF outfall
- Construction of additional structures/modifications at Pease WWTF
- Operating and Maintenance costs (Exeter conveyance and Pease WWTF)

Note: the cost of Stratham's collection system is not included.

5.2 Project Schedule

Due to the limits set by Exeter's AOC there is a time table that needs to be met. The AOC (Appendix E) states that construction shall begin by June 30, 2016 and by June 30, 2018 achieve substantial completion of the WWTF. Table 5 describes the probable time-line for the regional option, once all parties agree. The AOC would likely need to be modified if a regional option is pursued.

Table 5: Project Schedule

	Year 1	Year 2	Year 3	Year 4	Year 5
Design Conveyance					
Design Pease Treatment					
Permitting/IMA					
Construct Conveyance					
Construct Treatment					
Begin Operations					*

6.0 Opportunities and Challenges

There may be other opportunities and challenges associated with a regional option. Some of them are identified here.

- Opportunities
  - Although this evaluation has not included the flows, the conveyance system may be adequate to accommodate additional minor flows such as Newfields and Greenland. The force main could also be enlarged to include additional flows such that might come from Newmarket, Durham, Raymond or Epping.
  - Eliminates direct WWTF discharge into the Squamscott River and Great Bay and moves the discharge to the Piscataqua River where there is greater dilution.
  - By utilizing the existing lagoons as storage, this option (or any option that doesn't need the lagoons) could reduce or eliminate Exeter's CSO (Combined Sewer Overflow)
  - A regional solution provides a larger user base, which could reduce rates.
  - May improves the treatment process at Pease because of Exeter's equalized flow that is primarily residential (non-industrial)
  - Solution is consistent with the Southeast Watershed Alliance mission statement (investigate regional solutions)
  - Conveying Pierce Island sanitary flows to Pease for treatment could provide further economy of scale. Although not part of this study, if Portsmouth were to also convey Peirce Island sanitary flows to Pease, there would likely be significant additional benefits to all of the communities for this regional option.Local regional solution may foster further advocacy of larger regional solution such as a Hampton connection and a new ocean outfall or utilize existing Seabrook station outfall.
- Challenges
  - Is increased flow at existing Pease outfall acceptable to regulatory agencies and/or other agencies such as the Food and Drug Administration (FDA)?
  - Need to obtain approvals between the communities (IMA). This will require cooperation and political will.

- Possible private ROW access depending on chosen interceptor route alternative.
- Timing of work (need to comply with AOC deadline).

7.0 Conclusions

1. Project Drivers
    a. Exeter is currently under an EPA Administrative Order on Consent to meet discharge limits set by their NPDES Permit.
    b. Compliance must be by June 2018.
    c. Both Exeter and Stratham are interested in identifying the most cost effective solution for wastewater treatment and disposal.
    d. This study evaluated a regional wastewater option by conveying Exeter and Stratham's wastewater to the Pease WWTF.
2. Conveyance System
    a. This evaluation assumed one pumping station located at the Exeter WWTF. The design point is: 2,600 gpm (3.7 MGD).
    b. Stratham would connect by pumping their wastewater to the Exeter WWTF headworks.
    c. A 20" HDPE force main is proposed.
    d. Three alternatives were considered that varied in length (11.2 miles to 12.7 miles).
    e. Two of the routes considered existing utility corridors (PSNH and Unitil) because they are shorter and avoid traffic issues.
    f. Alternative 1 is the longest interceptor route evaluated at 12.7 miles, but is the most practical route because of unknown and costly easement issues in the other two alternatives.
        i. Regional Interceptor would be installed within the shoulder of the NHDOT ROW
        ii. Construction and maintenance would be easily accessible.
3. Pease WWTF
    a. A new headworks would be constructed to handle the additional flow from the regional interceptor.
    b. Additonal sequencing batch reactors would be constructed.
    c. Additional primary clarifiers may be needed to handle disinfection and solids.
    d. The Pease WWTF outfall would have to be modified to handle additional flow.
    e. Permitting issues with expanding the Pease outfall may require a portion of the Pease effluent to be conveyed to the Peirce Island WWTF. This would require additional capital and O&M costs.

4. Opportunities
    a. Environmental benefits may be realized by relocating discharge point downstream of the Great Bay.
    b. Future permitting requirements will be better managed with regional solution.
    c. Provides a regional solution to wastewater treatment with a larger user base and potential lower user rates.
5. Challenges
    a. Permitting increased flow at Pease WWTF outfall may be problematic.
    b. Private ROW issues depending on conveyance paths.
    c. Project could take 5 years to complete given need to work with neighboring communities.
    d. Intermunicipal cooperation may be time consuming.

8.0 Recommendations

Based on this evaluation, the following is recommended:

- Compare regional costs from this study to those costs presented in the pending Facility Plan.
- Continue to discuss opportunity with Portsmouth.
- Monitor Portsmouth's discussion on conveying Peirce Island's sanitary waste to Pease. This may provide additional cost incentives to a regional Pease option.

Appendices

A. Figures

- **Node Map**
- **Alternatives 1,2,3**

B. Meeting Notes

C. Case Studies

D. NHDES Administrative Order on Consent

E. Opinion of Costs

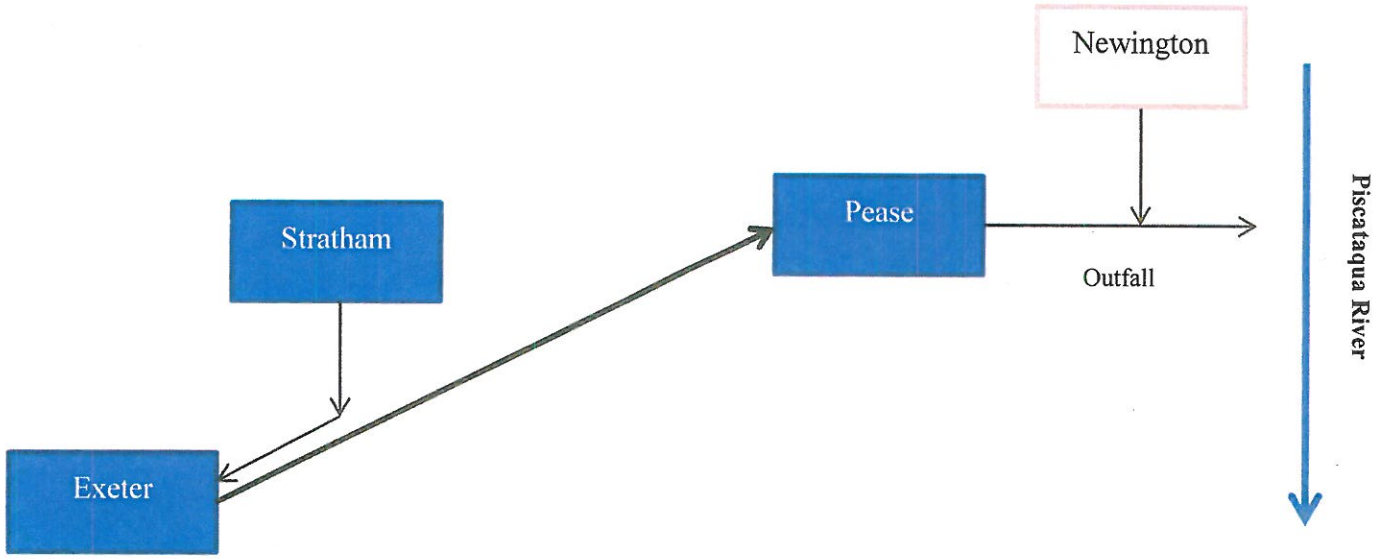
- **WWTF Costs**
- **Conveyance Costs**

F. Calculations

- **Pump Calculations**
- **Conveyance Calculations**
- **Flow Calculations**

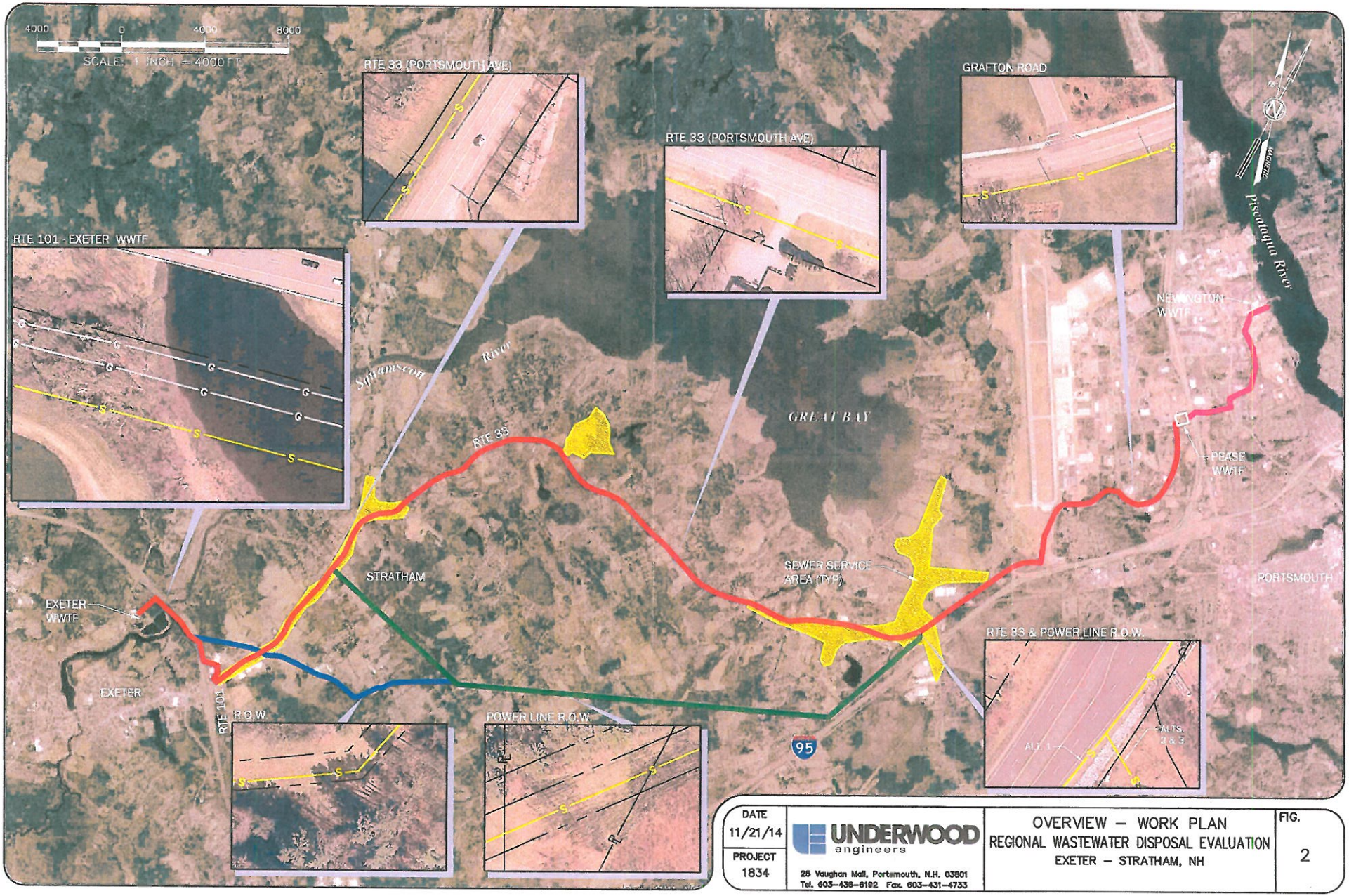
Appendix A: Figures

Figure 1: Regional Disposal Node Map Evaluation



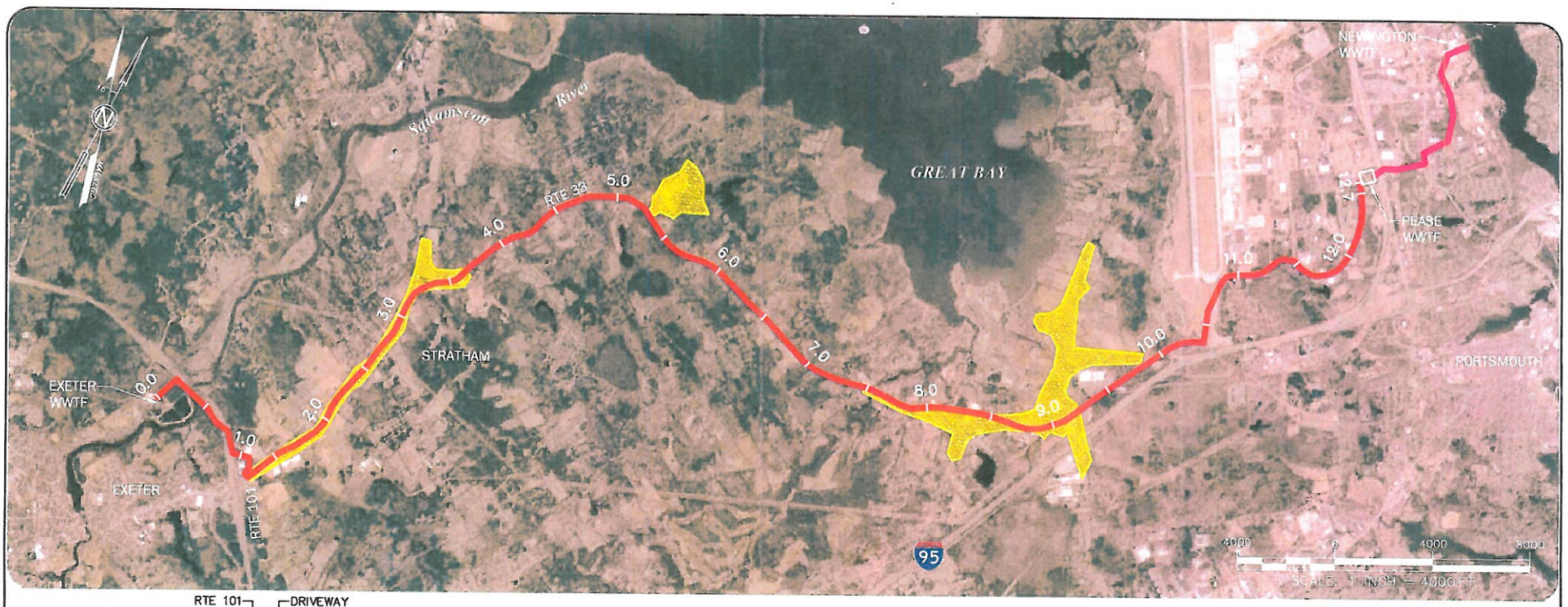
Note: Although, not evaluated in this study, additional communities could potentially connect to this force main such as Newfield, Newmarket, Durham and Greenland. Portsmouth is also considering the conveyance of Peirce Island WWTF to Pease WWTF.

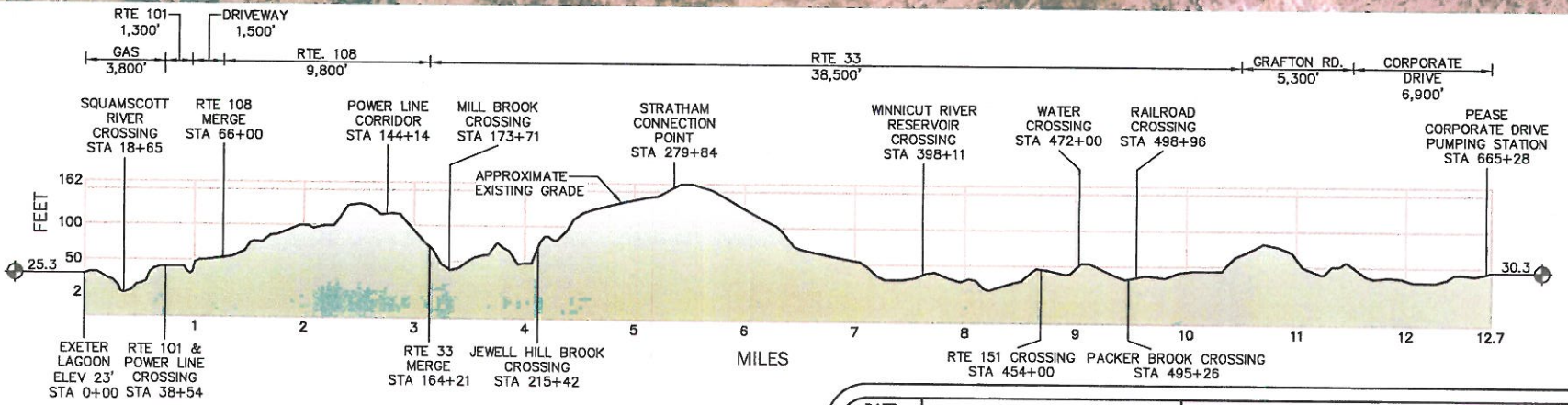
	Evaluated Communities
	Existing Connection



DATE		FIG.
11/21/14	OVERVIEW – WORK PLAN REGIONAL WASTEWATER DISPOSAL EVALUATION EXETER – STRATHAM, NH	2
PROJECT 1834		

UNDERWOOD engineers
25 Vaughan Mall, Portsmouth, N.H. 03801
Tel. 603-436-6192 Fax. 603-431-4733





DATE			FIG.
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PROJECT 1834	25 Vaughan Mall, Portsmouth, N.H. 03801 Tel. 603-436-8192 Fax. 603-431-4733		

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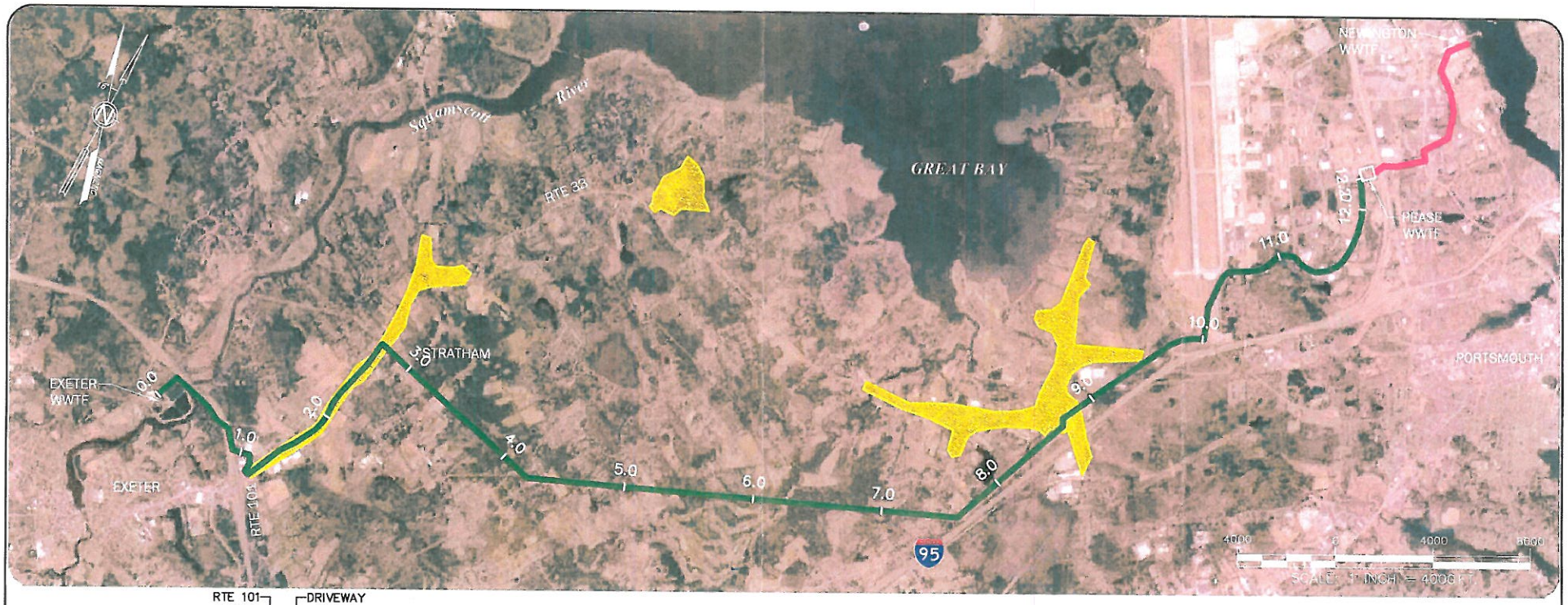

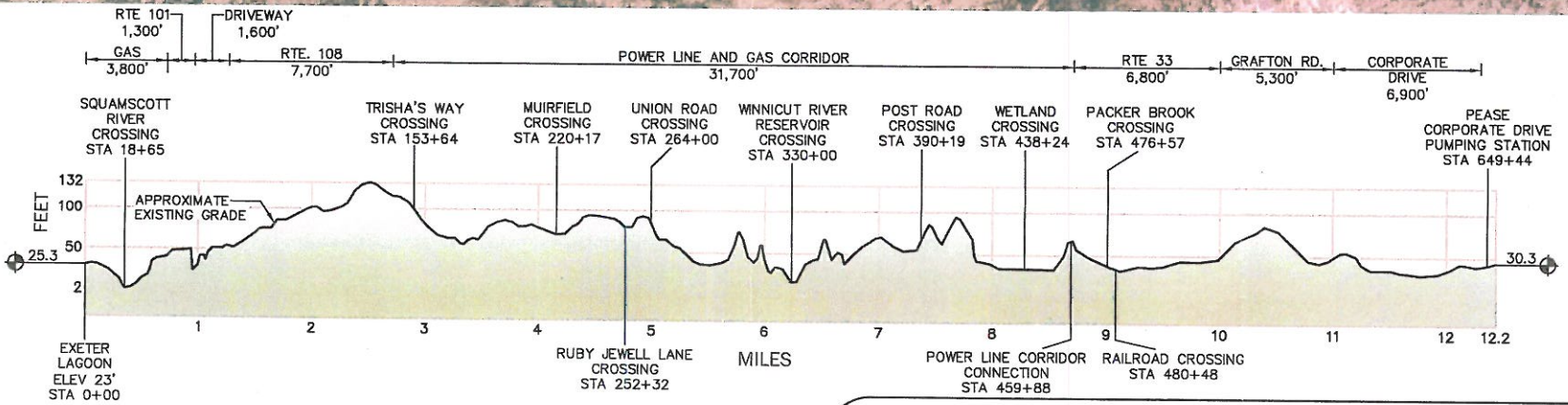

DATE			FIG.
11/14/14	UNDERWOOD engineers	ALTERNATIVE 2 REGIONAL WASTEWATER DISPOSAL EVALUATION EXETER – STRATHAM, NH	4
PROJECT 1834	25 Vaughan Mall, Portsmouth, N.H. 03801 Tel. 603-436-6192 Fax. 603-431-4733		

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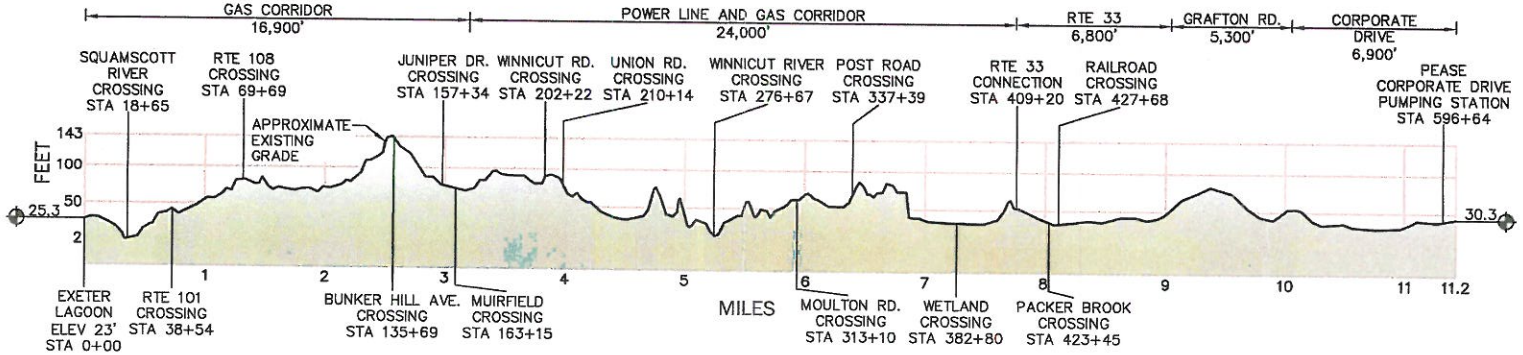

DATE			FIG.
11/14/14	UNDERWOOD engineers	ALTERNATIVE 3 REGIONAL WASTEWATER DISPOSAL EVALUATION EXETER – STRATHAM, NH	5
PROJECT 1834	25 Vaughan Mall, Portsmouth, N.H. 03801 Tel. 603-436-8192 Fax. 603-431-4733		

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